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G11B 23/28

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None

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G5R
Selected US specifications from IPC sub-class
G11B

(54) Playback and recording of copyright material

(57) Modules are incorporated in playback and recording machines to make operation dependant on the presence of a key which represents a licence to use, recordings carrying a recorded log of copyright uses that is brought up to date with each transaction. The idea is said to be applicable to other forms of copyright.

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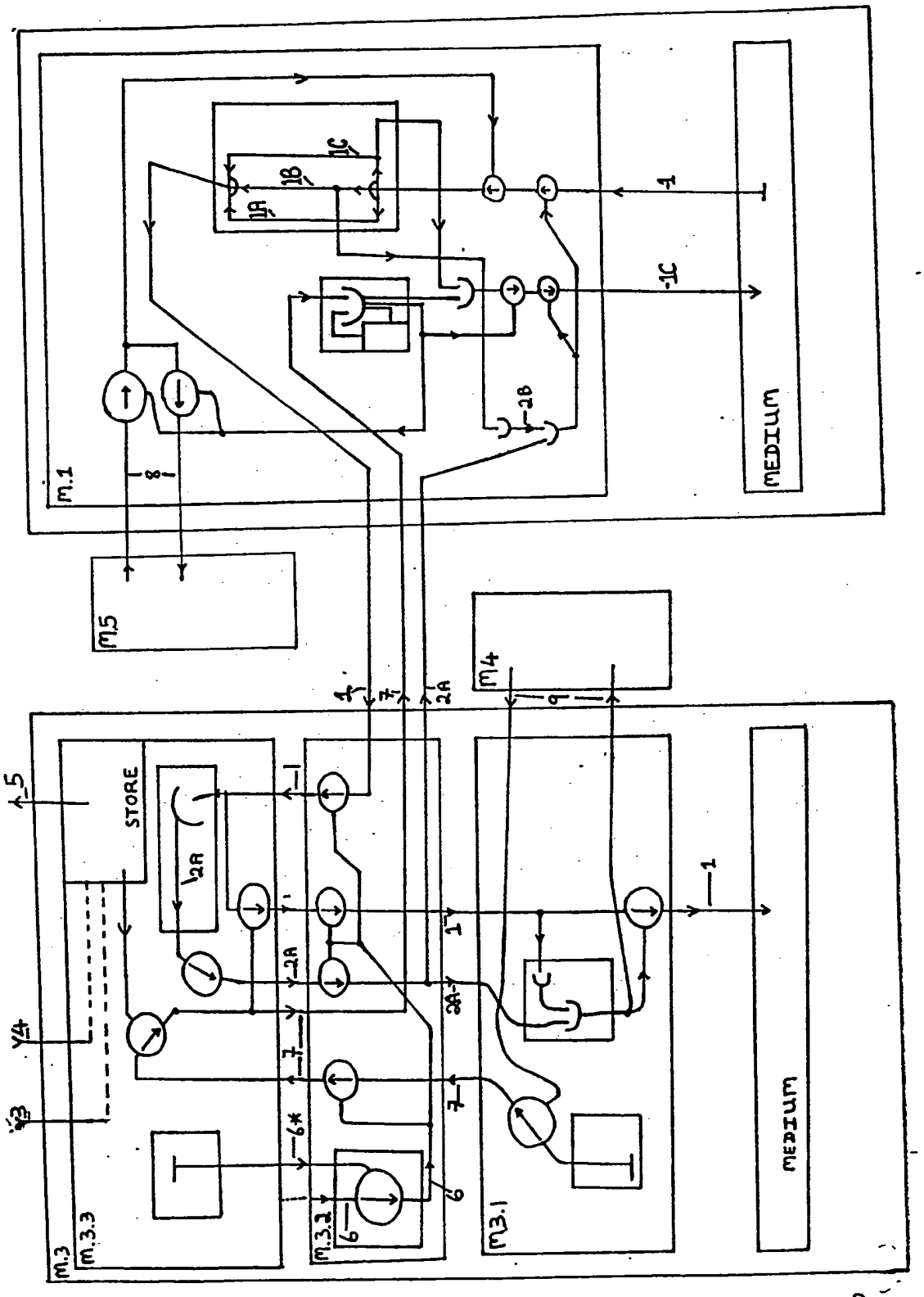
m.1
m.5
m.4
m.3
m.3.3
m.3.2
m3.1
STORE
MEDIUM
MEDIUM
1A
1B
1C
2A
2B
Y4
Y3
Y5

Fig 1

Fig2

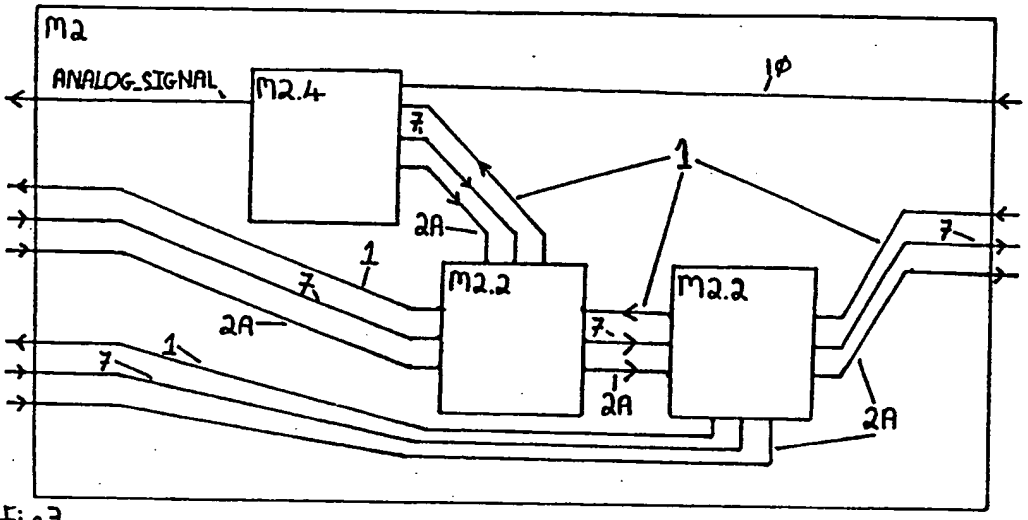

Fig3

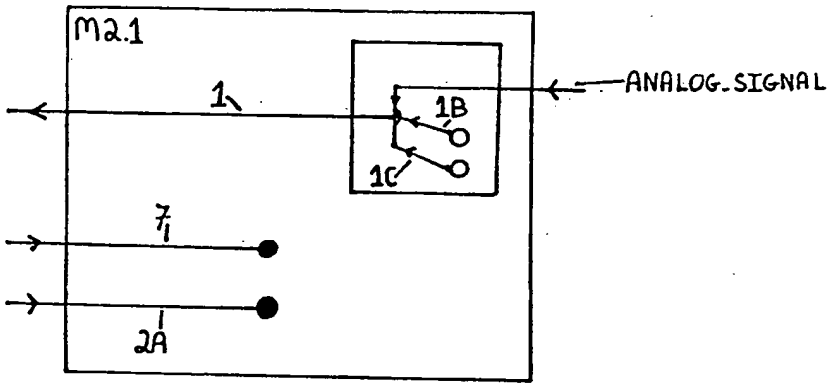

Fig4

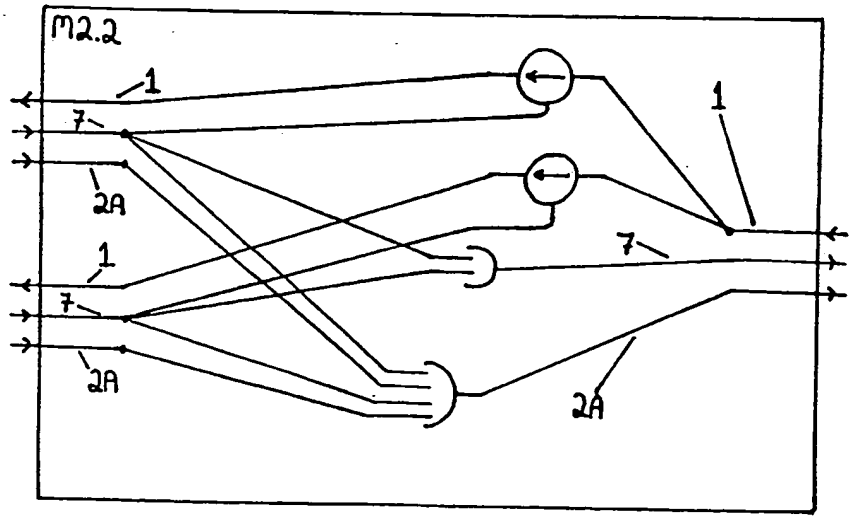

Fig5

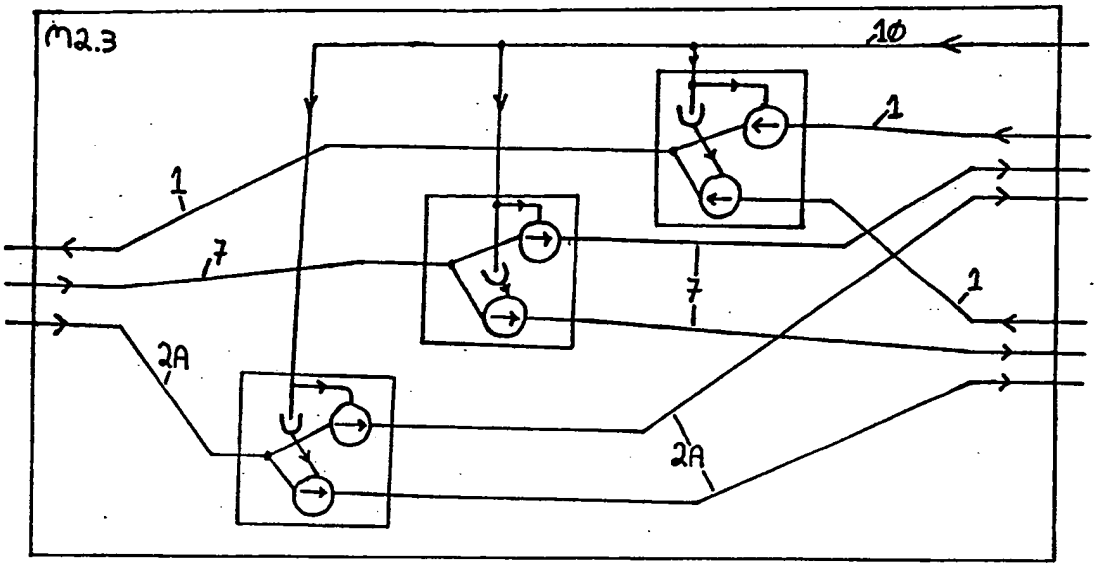

Fig6

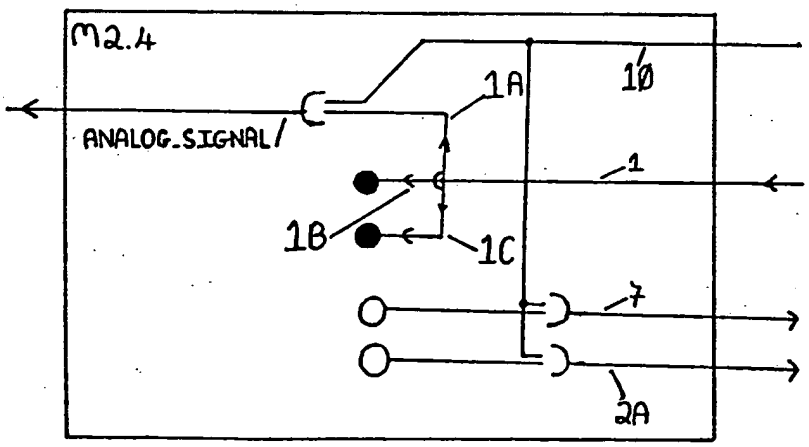

Fig7

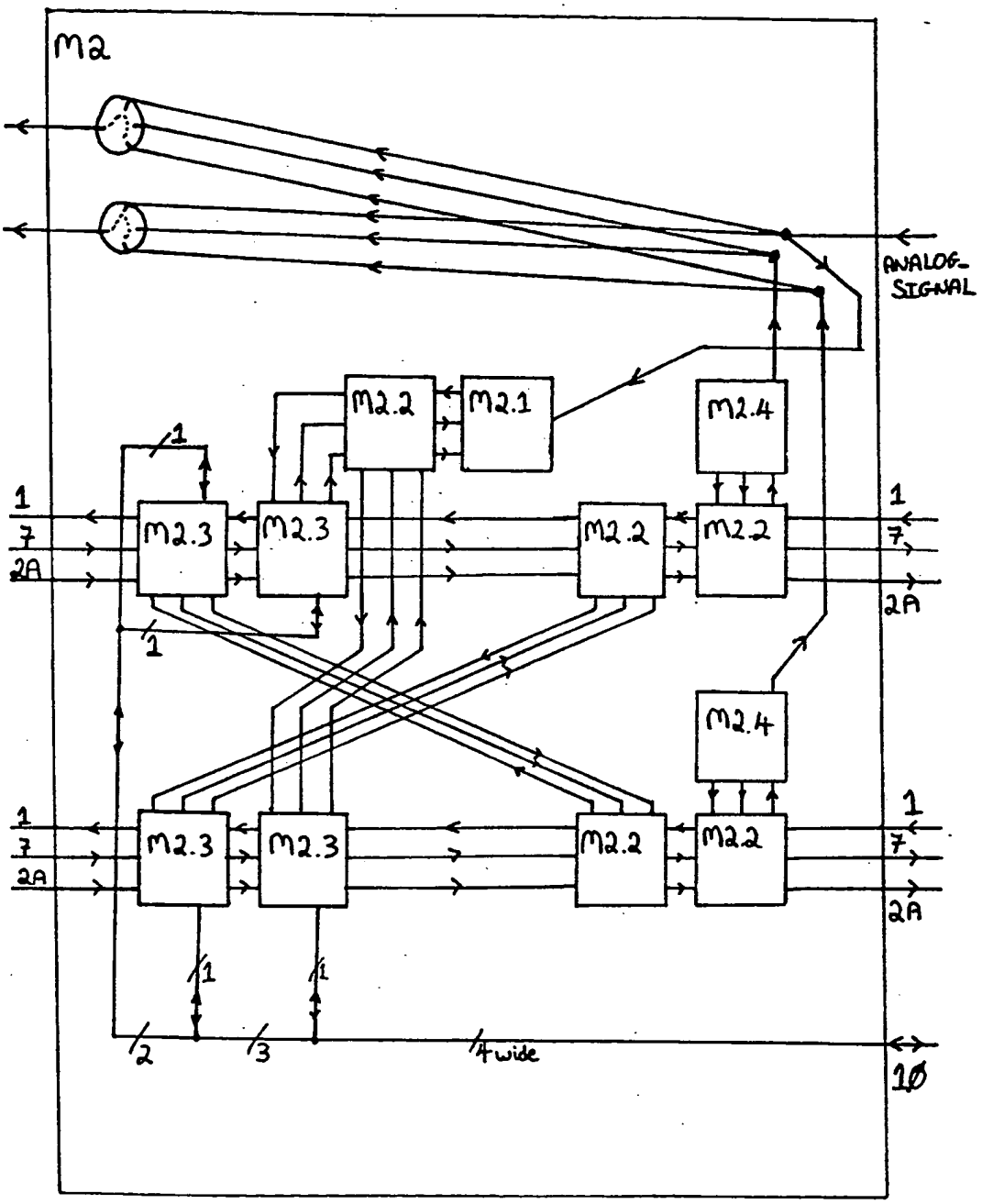

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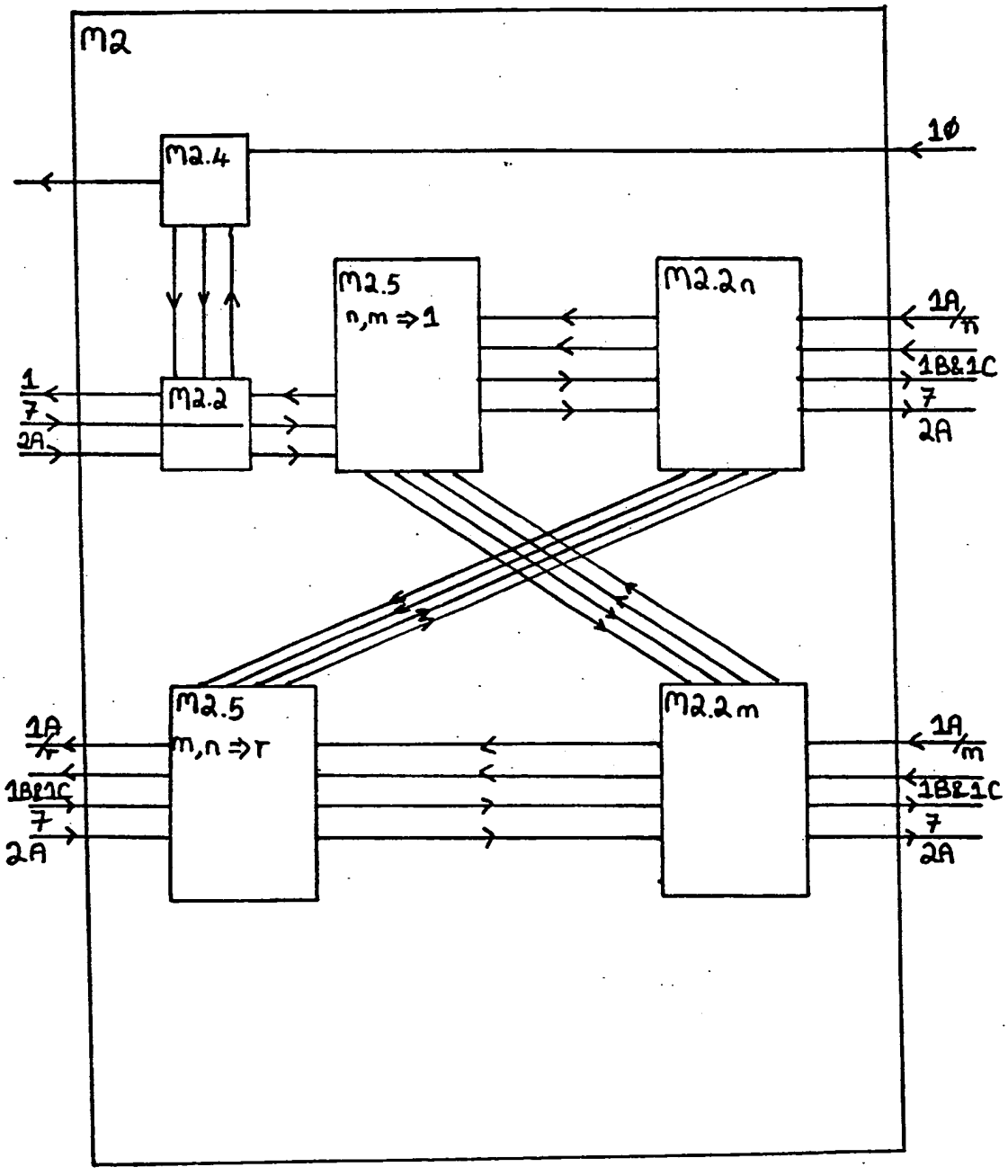
Fig 8



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SECURE DISTANCE PRODUCTION METHOD FOR OBJECTS COVERED BY INTELLECTUAL PROPERTY RIGHTS

This invention relates to ensuring the recognition of originators of objects covered by intellectual property rights whenever such an object is generated at a distance by means of a standard method of production.

Intellectual property rights are associated with patterns in some medium. Owners of intellectual property rights receive royalties of some kind when an instance of their pattern is generated under licence by any other entity.

The most widely known intellectual property rights are PATENTS and COPYRIGHTS.

As technology advances both of these will come under pressure from new methods of production available to entities whose activities will become difficult to detect unless the nature of the means of production of patterns in space_time reflects the need to monitor the production of instances of patterns as an integral part of the function of the production of an instance of the pattern.

Accordingly, this invention adresses the need for integrated production and production monitoring of such objects.

The required basis for the utilization of this invention for each type of pattern is :-

1) Standard formats for the representation of each type of pattern.

2) Standard formats for the representation of information identifying both the instantiation of each type of pattern and the instantiation of the instantiation of each type of pattern.

3) For each (1),(2) pair, a system for securely producing copies of an instance of each type of pattern under licence, while monitoring and recording that production.

4) For each production system (3), a method of inspecting that part of the secure production system (the licence) which monitors and records the licenced production events in such a way that the entity producing and the space_time location of the production event are not relevant.

According to the present invention there is provided a framework which can be instantiated to integrally produce and monitor the production of instances of types of pattern.

A specific embodiment of the invention will now be described by way of example with referance to the accompanying drawings in which :-

Figure 1 shows a minimal system which will directly copy a source into another area within which the pattern may exist.

Figure 2 shows a simple module capable of interfacing between the main modules shown in figure 1.

Figure 3 shows an analog => digital transmission module.

Figure 4 shows a Digital => Digital, Digital transmission module.

Figure 5 shows a Digital, Digital => Digital transmission module.

Figure 6 shows a Digital => Analog module.

Figure 7 shows an extended monitorable transmission module.

Figure 8 shows a version of this system extended to increace it's versatility.

The specific embodiment of the invention to be described is a copyright control system for digitally encoded copyright works. The method of the invention requires that a copyright item to be controlled by this system has a standard_format used to represent the sensitizable form of the copyrighted work for each type of copyrightable material. It further requires that codes be recorded with the copyright item, uniquely identifying that item and that a record_history tree position code be recorded with each copyright item, uniquely identifying each copy of that copyright item's root and twig recording history.

That is to say, a representation of a copyright work should contain along with the signal minimally required to represent the sensitable form of the work a signal describing or associatable with the copyright of the work and the production history of the work.

The invented method requires that licences exist to enable copies of the pattern to be created. These shall be refered to as keys. They must contain information describing the works produced and the quantity of each work produced and shall in this instance be assumed to do so using [code,count] pairs. Blank keys would be set to ([UNCOPYRIGHTED , 0] , [ANALOG , 0] , [BROADCAST , 0] , {^8K*[nil , 0] }) and be available through authorised outlets.

When a new instance of a standard digital copyright source work is produced the copyright code and appropriate record_tree code must be recorded with the new copy; the source copy's record_tree code should be updated to reflect the production event; the key should be informed of the event, either initializing a new copyright code field, or identifying an existing code, then incrementing the count field of the appropriate [code , count] pair.

In the case of ANALOG, BROADCAST and UNCOPYRIGHTED source material, the algorithm can be similar, however within the key, it would be erroneous for the code field not to exist; no change would be made to a non_existant field on the source, unless the source were to be a digital recording of a previous recording of an ANALOG, BROADCAST or UNCOPYRIGHTED source.

The licence key could either be retained by the authorised inspection center on inspection, or set to permit no further production to occur under it's control.

The data types flowing through the example system, and the system modules and sub_modules shall now be identified and their interfaces and the behaviour of system modules and sub_modules shall be specified for the systems in terms of the diagrams, figures 1 and 2. Figure 3 shall be refered to later.

Main Data types

to be processed by hardware modules and sub_modules

1) A - copyright_work sensitable_form describing data

B - copyright_work copyright_code data

C - copyright_work record_history_tree data

2) A - Type A key check data

B - Type B key check data (2A=2B v 2A/=2B)

3) key interogation data

4) key command, modifying data

5) key state data

A - [copyright_code, count] pairs of data items

B - licence inspection state data

6) key present data

6*) complex key present data

7) record_event occuring data

8) reader monitor data

9) writer monitor data

10) transmission monitor data

The neccessity to maintain the correct relationship between copyright data (1B), instance data (1C) and the work to which they refer (1A) during all reasonably predictable events within a configurable system manifests itself in the specifications of hardware modules.

Software solutions in terms of extra data (2 and 6) are also being suggested as ways to monitor the configurations of hardware modules and submodules. When the data presented to legal modules indicates legal modules to have been

incorrectly configured, they modify their behaviour.

Type 2 data is used to ensure the presence of a key within a recording system. Type 2A data is generated within the key (M3.3) and passed to both the write_head (M3.1) and the read_head (M1) supplying the write head (M3.1) with data. Both types of head generate type 2B data to compare with the type 2A data. The comparison must be favourable to permit reading or writing to continue.

An algorithm to scramble the logical_physical ordering of bits within a signal at read head, lock, key and write head is a possible security oriented extension. Security data passed between other interface componants in a manner designed to ensure the presence of a correct configuration of modules is a further extension.

Main Modules and Sub_modules

M1) Read module

A module capable of reading a representation of a copyright work, reads and transmits unaltered all type 1 data. Type 1C data is a special case. Type 7 data is combined with type 1C data to produce type 1C data to replace the type 1C data being read from the source on the source.

Inputs :

source is copyright work :

type 1

source is transmission interface :

type 7, type 2A

source is read_monitor :

type 8

Outputs :

destination is read monitor :

type 8

destination is copyright work :

type 1C (<= (type 1C, type 7))

destination is transmission interface :

type 1 (<= type 1)

destination is ANALOG :

type ANALOG_signal

A head sub_module (M1 and M3.3) is a precision device, holding it's control circuitry within it in such a way as to make the control circuitry innaccessible without disturbing the precice allignment of the device, a precice allignment without which the device will not function, which is only reallignable utillizing very high precision devices.

Any change occurring to the type 7 data being recieved by a read device results in the read device raising an exception and processing it automatically, under control of the internal control circuitry.

The type 7 data can either indicate the addition, or the loss of a recording module from the configuration. In the case of an addition, the head isolates itself from external control, output would terminate, and the read event would continue at maximum speed, updating all type 1C data to the value written during the valid part of the recording: control would then be permitted to return to the monitor. In the case of a loss, the only change is a rapid update of the head's concept of expected type 7 data, the read event would continue, and the updated type 1C data would not change. Were a source to be corrupted due to power failure at some stage during some production event the type 1C data being written onto a source does not reflect the discontinuity, but updates all parts of the data to the current correct value, as indicated by the initial type 1C and type 7 data.

The read device processes type 1 data into type 2B data which, when type 7 data indicates a recording to be progressing, is compared with type 2A data being received. If the comparison is unfavourably made at any time during a recording, an exception is raised, gracefully terminating the play event under internal circuit control as described above for detection of increaced recording in type 7 data.

Power connections, start_play, stop_play, play_monitor data conections also exist for such devices (M5 and type 8)

M2) Transmission modules

A transmission module flexibly distributes signals from sources to destinations. To do this requires sub_modules, of various types, which may be physically configured and logically connected in many ways. Security should be retained for all connectable configurations of these types of module.

The encapsulated behaviour of transmission modules should be such that any digital output is identical to the digital input from which it derives, else, deriving from an analog source, it should carry ANALOG, BROADCAST or UNCOPYRIGHTED copyright codes.

The data transmission directions indicate the direction in which the main data is flowing. Type 7 and type 2A data should be understood to flow in the opposite direction along the same set of connections, and possibly to be altered while passing through a transmission module.

M2.1 Analog => Digital

This module is required to permit digital recordings to be made of analog source material, be the source material copyright or self_created.

It seems difficult to make the types of device required to produce ANALOG, BROADCAST or UNCOPYRIGHTED incompatible or differentiable, as such they shall be considered to be similarly treated.

The sub_module has the following features.

```
Inputs :
  source is ANALOG :
     type ANALOG_signal
  source is case
          (transmission interface ! write) module :
     type 2A, type 7
Outputs :
  destination is case
          (transmission interface ! write) module :
     type 1[A,B,C] ( <= [ANALOG_source ,
                         'BROADCAST' ! 'ANALOG' !
                         'UNCOPYRIGHTED',
                         'nil'                    ])
```

The type 2A and type 7 data have no purpose in this module but are included for consistancy. They need not be processed in any way.

The analog source signal must be digitised into the standard format expected by the system.

The copyright code to be output derives from an internal constant. It would be expected that acceptable systems would use more ANALOG and BROADCAST sub_modules of this type than UNCOPYRIGHTED sub_modules.

The record_tree code is also a constant. This code represents the root, that recording, number user_zero, from which has yet been derived no other recordings.

M2.2 Digital => Digital, Digital

This sub_module is required for signal splitting in the mixer stage of transmission and has the following properties :-

Inputs :

source is case

(transmission interface ! read) module :

type 1

source is case

(transmission interface ! write) module :

type 2A, type 7

source is case

(transmission interface ! write) module :

type 2A, type 7

Outputs :

destination is case

(transmission interface ! read) module :

[type 2A, type 7]

{ <= [(type 2A, type 7, type 2A, type 7),

(type 7, type 7)] }

destination is case

(transmission interface ! write) module :

type 1 { <= (type 1, type 7, type 7) }

destination is case

(transmission interface ! write) module :

type 1 { <= (type 1, type 7, type 7) }

The type 2A outputs are derived from all type 2A and type 7 inputs.

The type 2A outputs are undefined if both type 7 inputs indicate no recording to be occurring. If one type 7 input indicates a recording is occurring, it's type 2A signal is transmitted unchanged. If both type 7 inputs indicate a recording to be occurring, the type 2A signals must be identical for transmission to occur.

The type 7 output derives from both type 7 inputs. Each input indicates the number of recordings being derived from the associated type 1 output. The derived output sums the inputs such that the type 7 output also reflects the number of recordings deriving through the node from the type 1 input.

The type 1A and type 1B data are transmitted from the input to both outputs unchanged.

The output type 1C data varies depending on the input type 1C data, both input type 7 data and the output channel through which it is transmitted. This is done in such a way that unique type 1C data is derived at each processing node.

M2.3 Digital, Digital => Digital

This sub_module permits the selection between various inputs under the control of a user monitor panel (M6) . At any one time, only one of the input signals is transmitted. The following features may be observed.

Inputs :

source is case

(transmission interface ! read) module :

type 1

source is case

(transmission interface ! read) module :

type 1

source is case

(transmission interface ! write) module :

type 2A, type 7

source is transmission monitor :

type 10

Outputs :

destination is case

(transmission interface ! read) module :

[type 2A, type 7]

{ <= [(type 2A, type 2A, type 10),

(type 7 , type 7, type 10)] }

destination is case

(transmission interface ! read) module :

[type 2A, type 7]

{ <= [(type 2A, type 2A, type 10),

(type 7 , type 7, type 10)] }

destination is case

(transmission interface ! write) module :

type 1 { <= type 1, type 1, type 10}

The type 10 data need in this case be a simple two state piece of data. It is the only source of variability in the behaviour of this sub_module.

Whichever source is being indicated by the type 10 data, the type 1, type 2A and type 7 data flow unchanged through the component between the selected input and the output of the component. The unselected input indicates with it's type 7 data that no recording is being derived from it.

M2.4 Digital => Analog

This module enables the production, for sensitization purposes, of amplifiable signals from digital signals utilizing the following interface features.

Inputs :

source is case

(transmission interface ! read) module :

type 1

Outputs :

destination is ANALOG :

type ANALOG_signal

destination is case

(transmission interface ! read) module :

[type 2A, type 7]

(<= [UNDEFINED, NO_CURRENT_RECORDING])

The input type 1A data is converted into it's analog form and output. All other type 1 data is ignored.

The type 2A and type 7 data derive from internal constants.

M3) Write modules

A write module processes information recieved from either a read module (3.1) or a transmission module (3.2) and encodes it onto some medium in the required format for representation of the type of copyright work being produced.

For the secure distance production of copyright works this module requires a number of sub_modules with clearly defined interface behaviours ensuring the sub_modules to be verrifiable. They are Write head (M3.1), Lock (M3.2) and Key (M3.3). The behaviour and features of these sub_modules shall be defined below.

This module is only capable of creating an instance of a digital copyrightwork when containing a lock mechanism containing a key with capability to monitor the nature of the recording.

A key detector (M3.2.1) utilizing a physical presence detector, possibly extended to a key emmission detector, is included in the lock (M3.2) to detect the presence or absence of a key.

A lock_key enables the write sub_module (M3.1) to perform it's task. This enabling takes the form of a digital signal (type 2A). The signal is derived from the current value of the copyright_work code (type 1B), and the latest value of other state description codes (type 5).

M3.1 Write head

This is sub_module checks the enable codes and transfers the copyright_work representation codes onto the medium holding the work. It posesses these features :-

Inputs :

source is lock sub_module :

type 1, type 2A

source is write monitor :

type 9

Outputs :

destination is lock sub_module :

type 7 (<= ('1_RECORDING':nil, type 9))

destination is recording media :

type 1 (<= (type 1, type 2A))

destination is write monitor :

type 9

The sub_module processes type 1 input into type 2B data which is compared with type 2A data being received, permitting recording of type 1 data iff the comparison is favourable In all other circumstances recording is terminated under internal control.

Type 7 data is generated by an internal constant of bit width dependant on the number of bits at each user level of the record_history (type 1C). When reproduction of a copyrightable work is occurring the type 7 data indicates such. At other times the type 7 data indicates zero recording to be being produced.

The last field of the type 1C data supplied to the key is incremented before transference to the current outer node of the record tree. The type 1C data recorded on the medium has a zero final field.

3.2 Lock

A lock of the following minimum specifications is required in the system to interface with a replaceable key. All data to and from the key is processed by the lock.

Inputs :

source is write module :

type 7

source is case

(transmission interface ; read) module :

type 1

source is key :

type 1, type 2A, type 7

source is key detector :

type 6

```
Outputs :
  destination is write module :
     [type 1, type 2A]
       { <= [(type 1.key, type 6), (type 2A, type 6)] }
  destination is case
          (transmission interface | read) module :
     [type 7, type 2A]
       { <= [(type 7.key, type 6), (type 2A, type 6)] }
  destination is key :
     [type 1, type 7]
       { <= [(type 1.case(transmission interface | read)
                module, type 6),
              (type 7.write module, type 6)            ]}
```

Type 6 data derives from a key detector integral to the lock. It's signal of key_present is one necessary condition for any data to be transmitted by the lock.

Type 2A data is derived within the key, and is passed through the lock to both write head and read head, or a transmission interface, but only when the lock detects the physical presence of a key.

Type 1 and type 7 data, iff a key is detected, is passed unprocessed through the lock.

Security could be tightened by increacing the complexity of type 6 data to include a more complex key detector :-

M3.2.1 Key Detector

Inputs :

source is key :

type 6*

source is physical detector :

BOOLEAN

Outputs :

destination is lock :

BOOLEAN

-- local to lock. This would
---------- give lock an extra source
-- source is key : -- which would derive from
-- type 6* -- secure circuitry within
---------- the key and need to be

compared according to some alogrithm held in secure circuitry within the lock with data held in the lock within secure circuitry. Use of PLA's or circuitry compiled to silicon level for this level of security would increace the level of technology required to subvert key detection by a lock only if the specifications were not circulated freely to interested manufacturers.

M3.3 Key

The key is the module, external to read or write heads, generating data derived from copyright works, which write heads need access to to continue producing a copyright work and read heads need access to, if they believe the process of generating a new instance of the copyright work is in progress, to continue reading.

The only connection of a key to a system is via a lock. This is to enable the replacement and inspection of keys at inspection centers. Other connections are supplied for the purpose of such inspection and have no effect on the process of creating an instance of the copyright work.

```
Inputs :
  source is lock :
     type 1, type 7
  source is inspection panel :
     type 3, type 4
  source is monitor panel :
     type 3
Outputs :
  destination is lock :
     [type 1, type 2A, type 7]
       { <= [  (type 1 , type 7, type 5),
               (type 2A, type 7, type 5), (type 7, type 5)] }
  destination is case
          (inspection panel : monitor panel) :
     type 5 { <= [(key_state, type 3) }
```

The key stores type 5A data in a secure form where the only operation on count is INCREMENT and a count may only be accessed after a [code,count] pair has been initialized.

It copies type 1 data unchanged from input to output while extracting a working copy from which to derive type 2A and type 5A data for output and recording purposes respectively. Type 7 data flows in the opposite logical direction to the type 1 data. All of these forms of data only flow if the type 7 and type 5 data incicate that recording is recordable and that only 1 recording is being derived from the signal passing through the lock, although this last condition is not absolutely necessa y.

Type 5A data derives from the type 1B data and the extant type 5A data. It is extractable for monitoring and inspection purposes when the key is supplied with type 3 data.

Type 5B data is preset and remains so until inspected, when it is permanently reset by type 4 data to prevent further use of the key.

If a more complex key detector was being used, type 6* data would also be transmitted to the key detector section of the lock.

--

-- destination is key detector

-- type 6*

-- (<= internal data)

--

M4 Write Control Monitor

This module processes type 9 data to monitor and control a write head (M3.1) as described above and shown in figure 1.

M5 Read Control Monitor

Similarly this module interfaces between an entity wishing to control and observe the production process and a module within a system effecting that process. In this case an M5 so interfaces for an M1 by means of type 8 data.

M6 Transmission Control Monitor

Similarly an M6 interfaces for an M2.3 by means of type 10 data.

An M6 may also be similarly used with the transmission interface (M2) sub_module (M2.5) as described below. It is a higher level analog of the M2.3 sub_module.

Extension of the System

The system described above represents an example of a genre of production systems. It operates on a simple type of object consisting of one encapsulated description of a copyright work. As an example this could be expanded to control the production of composite sets of such encapsulated descriptions. If the initial description described mono or

mono_chrome, an expanded system could process multi_track or multi_colour or indeed multi_track multi_colour copyright objects.

Type 1 data could be recorded on parallel tracks.

Standard 1, 2 or 4 track_width modules would exist for all modules described above. There is possibly redundant data recorded for security that need not be transmitted track_width times (type 1B and 1C). Readers could check to ensure this data is identical and filter the signal to one copy which production heads must regenerate at the production node.

Flexible heads and head monitors are also required in this expanded system, as are a new flexible type of transmission module and an associated monitor.

Flexible read and write monitors would need to be able to control with type 8 and 9 data the contiguous or disjoint sets of tracks within the fixed array of tracks dependant on the capacity of the medium of the copyright work being accessed by the heads. The heads themselves would ensure the validity of the selected tracks.

A type of transmission module (M2.5) instantiable with a wide range of input output track_widths and an associated monitor able to select sets of tracks from amongst the inputs of the module is required to connect the flexible heads to the standard width section of the system. This transmission module would impose identical conditions on the selected outputs as the read head, and similarly block transmission of incompatible selections.

Type 2A and Type 7 security data flows through this system in a way consistant with the above description for the simpler version of the system.

Read and write heads have been described as separate entities. While this is logically correct it need not be the only physical implementation of the description. It may indeed be preferable to permit logical read and write operations simultaneously within different parts of the same physical recording medium, each operation occurring under the control of logical read and write monitors logically behaving as described above and connected through some interface such as has been described.

Further information

Time constraints are critical for the system. Type 1 data from the reader must be able to reach the key to be checked against it's type 5 data and if acceptable permit type 7 data to flow from the key to reach the reader before the read head must update the type 1C data. Either test codes and states must be assigned for the system, or a test work should be available.

Security Evasion

The simplest solution to the problem of breaching security is to physically short the security circuits out of the system. That is, if a record head needs only the signal output from a read head, open the boxes and take the signal from the read head directly to the write head. If however the control circuitry of a legal head is tightly held within it's body, and microcircuitry, bearable only by disturbing a precision device, feeds the recording zone with a signal, such subversion becomes impossible without a high degree of technical support, or the use of illicit , illegally marketed modules compatible with specifications but sold giving no royalties to copyright holders. To discourage such activity, it could be possible to use PLA's and coded identification pair numbers calculated using military style prime number techniques, enabling forgery detection on inspection.

It is futher preferable that the history tree increment event described with M3.1 occur within the key, making the condition described as 'not absolutely necessary' in the description of M3.3 highly relevant.

A simple subversion device would have to generate type 2A data and null type 7 data, and pass type 1 data unmodified to the record head, however, both this and analog copies would spawn versions with identical type 1C data. Recording the 1C data on keys is an expensive possibility.

CLAIMS

1 A production method adressing the need for integrated production and production monitoring of objects covered by intellectual property rights.

2 A production method as claimed in Claim 1, wherein each type of object is associated with standard representation formats.

3 A production method as claimed in Claim 1 or Claim 2, wherein standard formats exist for the representation of information identifying the instantiation of each type of object.

4 A production method as claimed in Claim 1, Claim 2 or Claim 3, wherein standard formats exist for the representation of information identifying the instantiation of the instantiation of each type of object.

5 A production method as claimed in Claim 1, Claim 2, Claim 3 or Claim 4, wherein each represetation of identification information is unique.

6 A production method as claimed in any preceding claim, wherein a licence is an integrated part of the integrated production and production monitoring method.

7 A production method as claimed in any preceding claims, wherein each tuple of types of identification and representation information is associated with a system for securely producing copies of an object under licence while monitoring and recording that production event.

8 A production method as claimed in any preceding claims, wherein each tuple of types of identification and representation information is associated with a system for securely producing copies of an object from an abstract representation of that object under licence while mon ing and recording that production event.

9 A production method as claimed in any preceding claim, wherein each production method is associated with a method of inspecting that part of the secure production system (the licence) which monitors, records and enables the licenced production events

10 A production method as claimed in Claim 9, wherein each method of inspection takes no account of the producing entity.

11 A production method as claimed in Claim 9, wherein each method of inspection takes no account of the location at which production occurs.

12 A production method as claimed in Claim 10 and Claim 11, wherein both Claims are covered, simultaneously or selectively.

13 A framework from which production methods as described in the preceding claims may be instantiated.

14 A specific instance of the type of production system described in the preceding claims to produce or produce at a distance licenced copies of encapsulated mono, stereo or quadrophonic copyright material.

15 A specific instance of the type of production system described in Claim 1 through Claim 13 to produce or produce at a distance licenced copies of manipulable multi_track sound recordings of copyright material.

16 A specific instance of the type of production system described in Claim 1 through Claim 13 to produce or produce at a distance licenced copies of encapsulated single track visual or audio_visual copyright material.

17 A specific instance of the type of production system described in Claim 1 through Claim 13 to produce or produce at a distance licenced copies of manipulable multi_track visual or audio_visual copyright material.

18 A specific instance of the production system claimed in Claim 1 through Claim 13 and claimed in instantiated form in Claim 14 through Claim 17, wherein the representation of the copyright material is in a digital form.

19 A specific instance of the production system claimed in Claim 18, wherein some or all of the instantiation identification associated with the copyright material is in a digital form.

20 A production system as claimed in any preceding claim in which the user may only increment a count not initialize one, a function performed by an inspection center.

21 A production system substantially as described herein with referance to Figures 1 to 8 of the accompanying drawings.

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